Sulphur Recovery Guidelines for Sour Gas Plants in Alberta

August 1988

By ERCB and Alberta Environment

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EXECUTIVE SUMMARY

This report presents the decision of Alberta Environment (AE) and the Energy Resources Conservation Board (ERCB) respecting sulphur recovery guidelines for sour gas[1] plants in the province of Alberta. It culminates a review process which began in late 1985. The report also includes a summary of the review process and the recommendations and views of the participants.

[1] *Natural gas which contains hydrogen sulphide.*

AE and the ERCB periodically undertake a review of their sulphur recovery requirements to determine whether or not factors such as advances in technology or changing environmental or economic considerations warrant adjustments to the requirements. In the review of the current sulphur recovery guidelines, it was decided to involve representatives of the sour gas processing industry as well as representatives of Special Interest Groups and members of the broad public.

AE and the ERCB agree that generally, the sour gas industry operates well within Alberta's stringent standards for ambient air sulphur dioxide concentrations, and that there is no evidence to date that demonstrates that sulphur emissions from the sour gas industry have had a deleterious effect on local health or the environment within Alberta. They, however, continue to be of the view that the long term objective must be to limit atmospheric loading of pollutants, such as sulphur dioxide, to the extent that is practical. Therefore, insofar as workable and reliable technology appears to be available, they have concluded that some upward adjustment to the requirements would be in the public interest, particularly where the cost is not prohibitive.

Effective immediately, new plants sized at 2000 t/d or larger will be subject to sulphur recovery requirements which have increased from 99 to 99.8 per cent. Those with sulphur inlets of 50 to 2000 t/d will be required to achieve recoveries ranging from 98.5 to 98.8 per cent as compared to current requirements ranging from 96.2 to 98.8 per cent. New plants with inlets of 10 to 50 t/d will have recovery requirements increase from the range of 92 to 96 per cent up to a level of 96.2 per cent. All of these new recovery requirements should be achievable with the technology now typically in use for plants of the various sizes.

AE and the ERCB have little doubt that the new requirements will push the existing technology and operations to the maximum. It is also important to note that for individual plants, AE and the ERCB would consider requiring sulphur recovery levels higher than set out in the guidelines if a site-specific need were shown to exist.

In addition, AE and the ERCB believe that some degree of sulphur recovery should be required for plants in the 1 to 10 t/d size range. Sulphur recovery is not now required at such plants. AE and the ERCB will require a minimum sulphur recovery level of 90 per cent for plants between 5 and 10 t/d and 70 per cent for plants between 1 and 5 t/d.

With respect to plants in the 1 to 5 t/d range, AE and the ERCB have proposed to the government that a portion of the increased cost burden of sulphur recovery be carried by the public sector. The government has agreed to cover approximately 50 per cent of the cost of sulphur recovery by reducing a company's royalty liability.

The new requirements will apply to all new plants. They will also apply at existing plants when a capacity expansion of greater than 25 per cent or a substantial process modification is made. Further, when substantial new sour gas volumes which were not recognized in the original plant approval, are connected to an existing plant, the new sulphur recovery requirements will be imposed. The new requirements will not be applied to existing plants having a sulphur inlet less than 10 t/d.

In addition to the changed requirements at existing plants which undergo modifications, the performance of all existing plants greater than 10 t/d in size will be reviewed relative to the capability of the process in use. Where recoveries higher than now required by approvals are being reasonably attained or would normally be expected to be attained with the existing equipment, the approvals will be amended.

1 INTRODUCTION

This report presents the decision of Alberta Environment (AE) and the Energy Resources Conservation Board (ERCB) respecting sulphur recovery guidelines for sour gas[1] plants in the province of Alberta. It culminates a review process which began in late 1985 and involved input from the industry and public. The report also includes a summary of the review process and the recommendations and views of the participants.

[1] *Natural gas which contains hydrogen sulphide.*

The process began with a detailed review of the current requirements, as set out in IL 80-24[2], by a task force made up of staff from AE and the ERCB. Appreciation is due to the task force members who made a major contribution to the review and also to members of Special Interest Groups and industry who participated. Special thanks are given to Mr. Bob Clark of Carstairs, Mr. Stan Wilson and Mr. Larry Stafford, both of Nanton, who monitored the process and made suggestions on behalf of the broad public. The members of the task force and those who participated in the review are listed in Appendix I.

[2] *Energy Resources Conservation Board and Alberta Environment, November 1980.* ***Sulphur Recovery Guidelines - Gas Processing Operations****, Informational Letter IL 80-24. Calgary, Alberta.*

1.1 Review Process

The ERCB and AE periodically undertake a review of their sulphur recovery requirements to determine whether or not factors such as advances in technology or changing environmental or economic considerations warrant adjustments to the requirements. In the review of the current sulphur recovery guideline, it was decided to involve representatives of the sour gas processing industry as well as representatives of Special Interest Groups and members of the broad public because of the increasingly high-profile nature of sour gas processing in Alberta. A three-phase process was set up to allow for this involvement.

The first phase, completed in September 1986, was an ERCB/AE task force review[3] of sulphur recovery technology, economics, and requirements in other jurisdictions. The task force reached certain conclusions respecting available technology and its economics, and made recommendations respecting adjustments to the requirements.

[3] *Staff of Alberta Environment and the Energy Resources Conservation Board, September 1986. Sulphur Recovery at Alberta Gas Plants - Phase 1 of a Review of the Guidelines - Task Force Report. ERCB-AE 86-AA. Energy Resources Conservation Board, Calgary, Alberta.*

The second phase of the process provided an opportunity for the industry and Special Interest Group representatives to review the task force work, undertake their own studies, and make additional recommendations. It was hoped that a consensus might be reached at this stage, with industry, the Special Interest Groups, and public representatives reaching common ground with respect to recommended changes, but this did not occur. The positions of both sides remained very polarized, with industry arguing that the existing requirements are stringent enough, and the Special Interest Groups recommending best available technology (BAT)[4] for essentially all new plants. The public representatives generally agreed some increase in environmental awareness must be recognized in the review of the guidelines. The industry

and Special Interest Groups presented submissions[5,6,7] to the ERCB and AE to support their arguments.

[4] *A term which refers to the best technology that is available without regard to the economic practicality of its use.*

[5] *Alberta Petroleum Industry Government Environmental Committee (APIGEC) Industry Members Formal Submission regarding the ERCB - Alberta Task Force Report on Sulphur Recovery at Alberta Gas Plants, 27 February 1987.*

[6] *Special Interest Group submission and appendix prepared by Concord Scientific Corporation, entitled Sulphur Recovery at Alberta Gas Plants, Phase 1 of a Review of the Guidelines, A Critical Analysis of the Task Force Report. February 1987.*

[7] *Independent Petroleum Association of Canada (IPAC) Submission Re: Review of Sulphur Recovery Guidelines, 3 March 1987.*

The final phase of the review process was for the ERCB and AE to consider the recommendations of the task force, along with the submissions of others, and decide on the need for and extent of possible modifications to the existing guidelines.

1.2 Recommendations of the Task Force

The task force recommended several modifications to the current requirements which are presented in Figure 1. They included requiring a sulphur recovery efficiency of 90 per cent for plants having sulphur inlet rates between 5 and 10 tonnes per day (t/d). No recovery is presently required for plants having a sulphur inlet rate of less than 10 t/d. The task force's analyses of the cost of requiring increased sulphur recovery at these plants suggests a relatively low "marginal cost"[8] of $100/tonne (t) to $200/t for recovering sulphur. The costs would be higher than the current price of sulphur but considerably lower than the marginal costs for increased recovery in other cases studied by the task force.

[8] *The net cost, in excess of the value of sulphur, to recover an additional amount of sulphur.*

The task force concluded that the types of processes used by industry to meet the current guidelines, when operated effectively, are capable of achieving higher than currently required recovery levels. It therefore recommended that the required sulphur recovery levels be adjusted upward to reflect more closely the capability of the types of sulphur recovery and tail gas clean-up processes that would be installed at new plants. The task force contended that this would not necessarily mean a change in recovery levels achieved at new plants with sulphur inlet rates greater than 10 t/d but it would be a restatement of the requirements to match more closely achievable efficiencies. The primary objective here would be to convey more accurate information to the public regarding the sulphur recovery levels industry is achieving at new plants, and to remove a bias that causes Alberta's standards to appear less stringent than they really are.

Two of the four task force members also proposed further adjustments to the requirements based on "affordability" criteria which considered the impact of increased sulphur recovery on the calculated rate of return for a sour gas development. The further adjustments would result in essentially the highest recovery level being required for plants larger than 1000 t/d, instead of only for plants larger than 2000 t/d. As well, the intermediate recovery level achievable with sub-dewpoint technology[9] was recommended for plants larger than 25 t/d instead of only for plants larger than 50 t/d. These two task force members also proposed a recovery level of 70 per cent for plants sized between 1 and 5 t/d. These further proposed changes were not supported by the other two task force members because the marginal costs associated with the higher recovery did not seem justifiable to them.

[9] *Modification of the conventional Claus sulphur recovery process in which catalytic reactors are operated at reduced temperatures to enhance sulphur recovery efficiency.*

1.3 Recommendations of Industry and Special Interest Group Representatives

The industry representatives recommended that, at the present time, no changes be made to the existing guidelines as set out in Figure 1. In their view, there is no evidence to demonstrate that the existing requirements have not provided for adequate environmental protection. Further, the purpose of the Acid Deposition Research Program (ADRP) study is to determine conclusively whether or not sulphur dioxide emissions in Alberta are causing environmental damage. In the industry's view, it would be premature to impose higher sulphur recovery levels before the results of the ADRP study are known.

Industry representatives stated that requiring increased sulphur recovery would impose costs on the operators that would make the development of some sour gas reserves unattractive investments. They also claimed that the task force's representation of recovery levels achievable with equipment installed to comply with the current requirements overstates the capability of that equipment for long-term continuous operations. Setting the minimum requirements at those increased levels could cause the industry to have to use technology with increased capability and with higher costs.

The Special Interest Group representatives recommended that BAT be required for all new plants with a sulphur inlet rate of 10 t/d and greater. This position was based on analyses of the "average" unit cost of the total sulphur recovered, which indicated that BAT would be economic, rather than the marginal cost analysis that generally led the task force to conclude that it would not be economic.

The Special Interest Group representatives also concluded that requiring sulphur recovery at plants smaller than 10 t/d might make some sour gas projects uneconomic but that some sulphur recovery should be required for these plants in any event and the cost be offset by governments. They recommended that some intermediate recovery level be required for plants between 2 and 10 t/d that would take into account the costs. The Special Interest Group representatives also recommended that an appropriate sulphur recovery level for plants between 1 and 2 t/d be determined for each individual case that would depend on location, pollutant loading in the airshed, and proximity to populated areas.

The recovery levels recommended by the Special Interest Groups are compared to current requirements in Figure 2.

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2 THE NEED FOR CHANGES AND PROPOSED MODIFICATIONS TO THE REQUIREMENTS

AE and the ERCB agree with industry representatives that, generally, the sour gas industry operates well within Alberta's stringent standards for ambient air suphur dioxide concentration, and that there is no evidence to date that demonstrates that sulphur emissions from the sour gas industry have had a deleterious effect on local health or the environment within Alberta. They, however, continue to be of the view that the long-term objective must be to limit atmospheric loading of pollutants, such as sulphur dioxide, to the extent that is practical, particularly near urban or developed population centres where competing industrial interests and vehicle emissions contribute to the pollution load of airsheds. Therefore, insofar as workable and reliable technology appears to be available, it is concluded that some upward adjustment to the requirements would be in the public interest, particularly where the cost is not prohibitive.

Plants Greater than 10 t/d

On the basis of all of the evidence presented by participants and otherwise available, it is concluded that for plants with an inlet rate greater than 10 t/d, the task force position (proposed adjustment to reflect capability of equipment to meet IL 80-24 - Figure 1) should be accepted. This will raise the stated requirement for almost the entire range of plant sizes. New plants sized at 2000 t/d or larger will be subject to sulphur recovery requirements increased from 99 to 99.8 per cent. Those with sulphur inlets of 50 to 2000 t/d would be required to recover 98.5 to 98.8 per cent as compared to current recoveries ranging from 96.2 to 98.8 per cent. New plants with inlets of 10 to 50 t/d would have requirements increase from the range of 92 to 96 per cent up to a level of 96.2 per cent.

AE and the ERCB do not agree with the industry position that the above adjustments overstate the recoveries attainable with the particular technology. They recognize, however, that the recoveries represent the technology's capability at or near optimum operating conditions and may not be achievable on a continuous basis for all types of acid gas. Special circumstances would be considered in stipulation of recovery requirements for specific cases. Where shown necessary, a slightly lower (by 0.25 per cent or less) recovery requirement might be imposed for each quarterly period.

The task force alternative 2 proposal for plants from 25 to 50 t/d and 1000 to 2000 t/d is not accepted. These additional requirements, although possibly affordable in terms of typical sour gas projects, would involve substantial marginal costs for sulphur recovery. These costs are not justified given that new plants in these two size ranges will have to achieve relatively high sulphur recovery levels even without the proposed increase.

With respect to the Special Interest Group representatives' recommendation to increase requirements to BAT for all plants 10 t/d and larger, AE and the ERCB believe that the cost to impose a BAT standard generally on the gas industry is too high at this time. This would not preclude the consideration of BAT in cases where special circumstances might warrant its use.

The Special Interest Group representatives argued that in establishing minimum sulphur recovery levels for the province, the major emphasis should be on environmental considerations rather than economic. While AE and the ERCB generally agree with this position, it must be remembered that in addition to the imposition of minimum sulphur recovery requirements, gas plants have to meet all ambient air quality standards which have been set without consideration of economic factors. The primary objectives of provincial ambient air quality standards are "to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being" and "to provide a long-term goal for air quality and a basis for an anti-degradation policy for those parts of the country with pristine air quality and for the continuing development of control technology". These objectives correspond respectively to the maximum acceptable limits and the maximum desirable limits set out by the Federal/Provincial Committee on Air Pollution. In this regard Alberta's sulphur dioxide standards for ambient air concentrations are among the most stringent in North America.

AE and the ERCB note the argument of the Special Interest Group representatives that sulphur recovery requirements for new plants set on the basis of economic feasibility should have regard to the average cost of all of the sulphur produced rather than the marginal cost of the additional sulphur that would be produced if higher standards were applied. The question that must be answered, however, is whether additional costs, beyond the value of the sulphur recovered, should be imposed on the industry to increase recovery even though all environmental standards are being met and there is no evidence that existing plants are having harmful impacts on human health or the environment.

In these circumstances AE and the ERCB do not believe it would be appropriate to divert large amounts of

capital funds towards recovering small quantities of incremental sulphur at costs well beyond the value of the sulphur. To do so would be a misuse of funds that otherwise could be used for environmental research, research into increasing economic sulphur recovery, exploration and development of resources, or other more useful purposes.

It is important to note that this position to base sulphur recovery requirements on marginal rather than average economics is tempered somewhat by the desire to achieve as high a recovery as reasonably possible. The requirements are therefore set and interpreted in a manner which will result in more recovery rather than less. For example, AE and the ERCB have little doubt that the new increased requirements referred to earlier will push the existing technology and operations to the maximum and could result in situations where the last few tonnes of sulphur recovered have marginal costs greater than the value of the sulphur. Although prepared to move in this direction to a limited degree, AE and the ERCB believe that to impose a 99.8 per cent recovery on all plants greater than 10 t/d, as recommended by the Special Interest Group representatives, would divert too great an amount of funds towards the uneconomic recovery of sulphur.

It is also important to note that for individual plants, AE and the ERCB would consider requiring sulphur recovery levels higher than set out in the guidelines if a site-specific need were shown to exist.

Plants Less than 10 t/d

With respect to plants with inlet rates of 10 t/d or less, there is increasing public concern about emissions. This is particularly the case because these plants are not required to recover any sulphur under the current guidelines. While environment and health-effect studies do not identify these plants to be a problem, they are often viewed with open hostility by local residents and with each new application, the degree of public opposition is increasing, resulting in delays and significant costs to both government and industry. Given the geology of the province and assuming reasonable gas marketing prospects, one can expect to see an increasing number of new small sour gas plants. Also, although sulphur emissions from small plants currently do not represent a significant portion of total emissions in the province, an increasing number of these small plants without some level of sulphur recovery could result in their representing an increasing portion of the total. AE and the ERCB therefore believe that some degree of sulphur recovery should be required for these plants in order to help allay concerns of the public.

AE and the ERCB have decided to accept the task force proposed alternative 1 as shown in Figure 1. This will require a minimum sulphur recovery level of 90 per cent for plants between 5 and 10 t/d. This is believed reasonable in view of the relatively low marginal costs of such recovery, and in light of the fact that other jurisdictions generally require recovery at these levels. Although it is recognized that this sulphur recovery requirement would have a negative financial impact on the industry, overall it would be relatively insignificant and should not affect sour gas developments in the longer term. It is important to note that imposition of sulphur recovery requirements on these plants with inlet capacities ranging from 5 to 10 t/d would be another example of requiring sulphur recovery even though its recovery using current technology would not be economic on a marginal cost basis.

AE and the ERCB have also decided to impose a minimum sulphur recovery requirement of 70 per cent (part of task force proposed alternative 2) for plants between 1 and 5 t/d. Recognizing that such sulphur recovery is imposed primarily to alleviate public concerns and because of the high marginal costs of removal of the sulphur at plants in this size range, AE and the ERCB believe that the public, through the government, should be involved in paying a portion of the increased costs. This would also be consistent with a suggestion made by the Special Interest Group representatives.

The public would, in any case, bear some portion of an increased cost to the sour gas industry to recover the sulphur because of reduced corporate income taxes. AE and the ERCB have proposed to the government

that a larger portion of the increased cost burden of sulphur recovery for new 1 to 5 t/d plants be borne by the public sector. The government has agreed to cover approximately 50 per cent of the cost of sulphur recovery by reducing a company's royalty liability. Continuation of government support will be reconsidered whenever these guidelines are reviewed.

The cost of sulphur recovery requirments at these small plants will thus be shared by the industry and the public through the government. Requiring sulphur recovery at these plants will not only assist in alleviating public concerns but will also encourage the development of new applicable technology. This will have the long-term effect of reducing the costs of the technology.

Summary of Changes

As a result of this review, the Alberta Sulphur Recovery requirements are changed as follows:

1. Recovery for plants greater than 10 t/d in size will be increased to levels more consistent with the capability of recovery technology currently used.
2. Plants in the range of 5 to 10 t/d will be required to recover or remove from the plant emissions at least 90 per cent of the inlet sulphur.
3. A royalty abatement policy covering one-half of the costs of recovering sulphur from plants with an inlet of 1 to 5 t/d has been adopted by the government. A minimum sulphur recovery requirement of 70 per cent will therefore be imposed on such plants.

These new requirements are illustrated in Figure 3.

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3 RETROACTIVITY OF NEW REQUIREMENTS TO EXISTING PLANTS

AE and the ERCB did not include in the terms of reference for the Task force, and thus for review by industry and the Special Interest Groups, the question of whether or not existing sour gas plants should be required to upgrade their sulphur recovery efficiencies to comply with the requirements for new plants. They excluded this question of "retroactivity of the new requirements" primarily because they did not know whether changes would be made to the requirements, nor if made, how extensive they would be.

The need for further "public" review of the retroactivity question has now been considered in the light of the changed requirements. Given the extent of the changes and the size range of the plants to which the major changes will apply, AE and the ERCB do not believe that an extension to the public review process is warranted. They have therefore included their position respecting the retroactivity of the new requirements in this decision report.

While it is clear that arguments can be made that emissions from older plants should be restricted to the same emission levels as those from new plants, there must also be regard for the costs that would be imposed on the industry to upgrade all existing plants and the remaining operating lives of these plants. Having regard for these matters, AE and the ERCB have concluded as follows respecting the application of the new sulphur recovery requirements to existing gas plants.

Plants Greater than 10 t/d

The new requirements for new plants larger than 10 t/d are the recovery levels achievable by the process type commonly used now for the particular size range. AE and the ERCB have decided that existing plants

should not automatically have to meet these new requirements. Indeed, for many older plants, upgrading to the new requirements would represent very significant capital expenditures, which in many cases would not be justified by the plant's remaining life. However, the performance of all existing plants within this category will be reviewed relative to the capability of the process in use. Where recoveries higher than now required by approvals are being reasonably attained or would normally be expected to be attained with the existing equipment, the approvals will be amended. AE and the ERCB are working on the details of the manner in which the review will be conducted but have not as yet finalized them.

Plants Less than 10 t/d

Although the sulphur recovery requirements are being extended to plants in this size range, there is no evidence that such plants are causing health or environmental problems. That, coupled with the unattractive economics of removing sulphur at such plants, has led AE and the ERCB to conclude that the new requirements should not be applied to existing plants.

4 EXPANDED OR EXTENDED OPERATIONS

Consideration was given to the need for higher recoveries when existing plants are modified. It has been decided that the new requirements should apply when a capacity expansion of greater than 25 per cent is made or when a substantial process modification is made at an existing plant. The above is intended as a general rule. In some cases, particularly at older plants which do not currently meet the requirements of IL 80-24, an expansion of less than 25 per cent could result in some upgrading of sulphur recovery being required, although not necessarily to the new requirement set out in this report.

.Also, concern has been raised that newly discovered gas reserves are being connected to older plants with lower sulphur recovery and thus technological advances and new recovery requirements are not being applied. AE and the ERCB believe that processing new gas through existing plants is not only sound from an economic viewpoint but also in terms of environmental impact. They would thus not wish to unduly inhibit this practice. However, they agree that it would be undesirable to allow this practice to result in substantially higher sulphur emissions in the province. Accordingly, where substantial new sour gas volumes which were not recognized in the original plant approval, are connected to an existing plant, the new sulphur recovery requirements will be imposed. It is difficult to quantify the actual volumes because they will be decided on a case-by-case basis by AE and the ERCB and hence may vary. However, in general, if the volumes are sufficient to satisfy a new plant of similar capacity to the existing plant for a period of 8 to 10 years, then the new sulphur recovery requirements will apply. As in the case of a capacity expansion, where new gas is connected to a plant with a recovery efficiency much lower than the new requirements. some upgrading of sulphur recovery efficiency may be required even if the new gas is not as significant as described above.

ISSUED at Calgary, Alberta, on 24 August, 1988.

ENERGY RESOURCES CONSERVATION BOARD

<signed by>

G. J. DeSorcy
Chairman

ALBERTA ENVIRONMENT

<signed by>

V. A. MacNichol
Deputy Minister

APPENDIX I - PARTICIPANTS IN THE REVIEW PROCESS

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ATTACHMENTS:

FIGURE 1 - Current Sulphur Recovery Requirements and Changes Proposed by the Task Force

FIGURE 2 - Current Sulphur Recovery Requirements and Changes Recommended by the Special Interest Groups

FIGURE 3 - Sulphur Recovery Requirements for Alberta Sour Gas Plants - August 1988

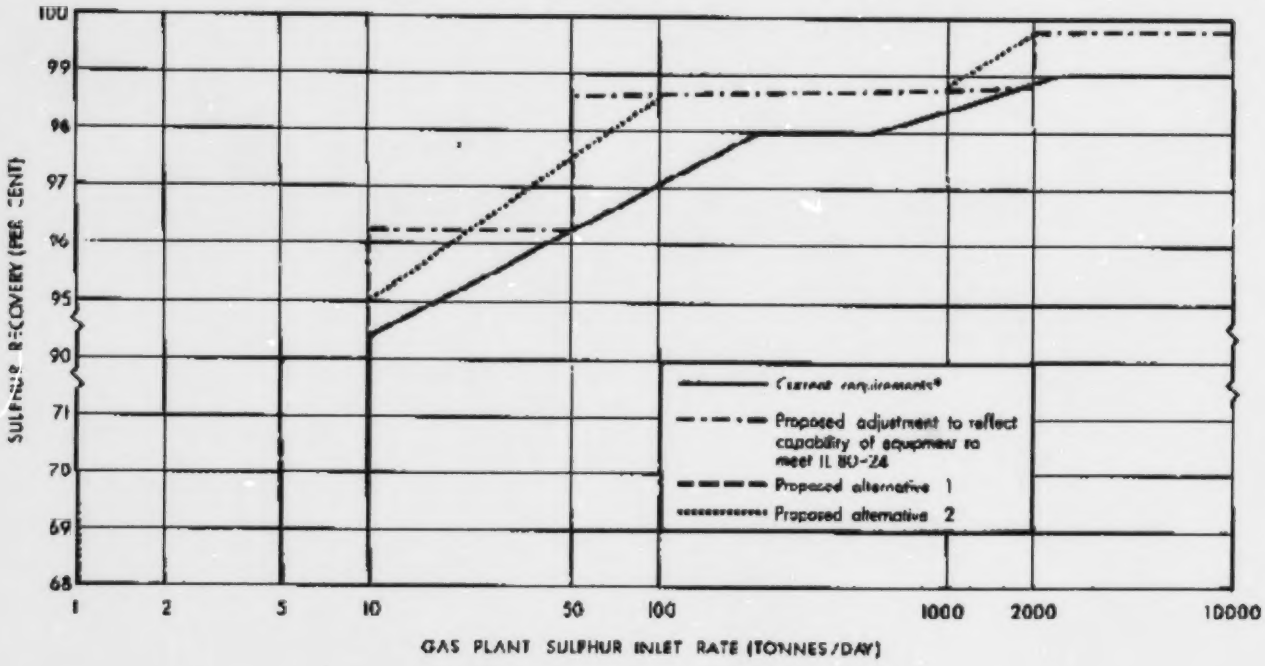

FIGURE 1 CURRENT SULPHUR RECOVERY REQUIREMENTS AND CHANGES PROPOSED BY THE TASK FORCE

*The industry recommended that no change be made

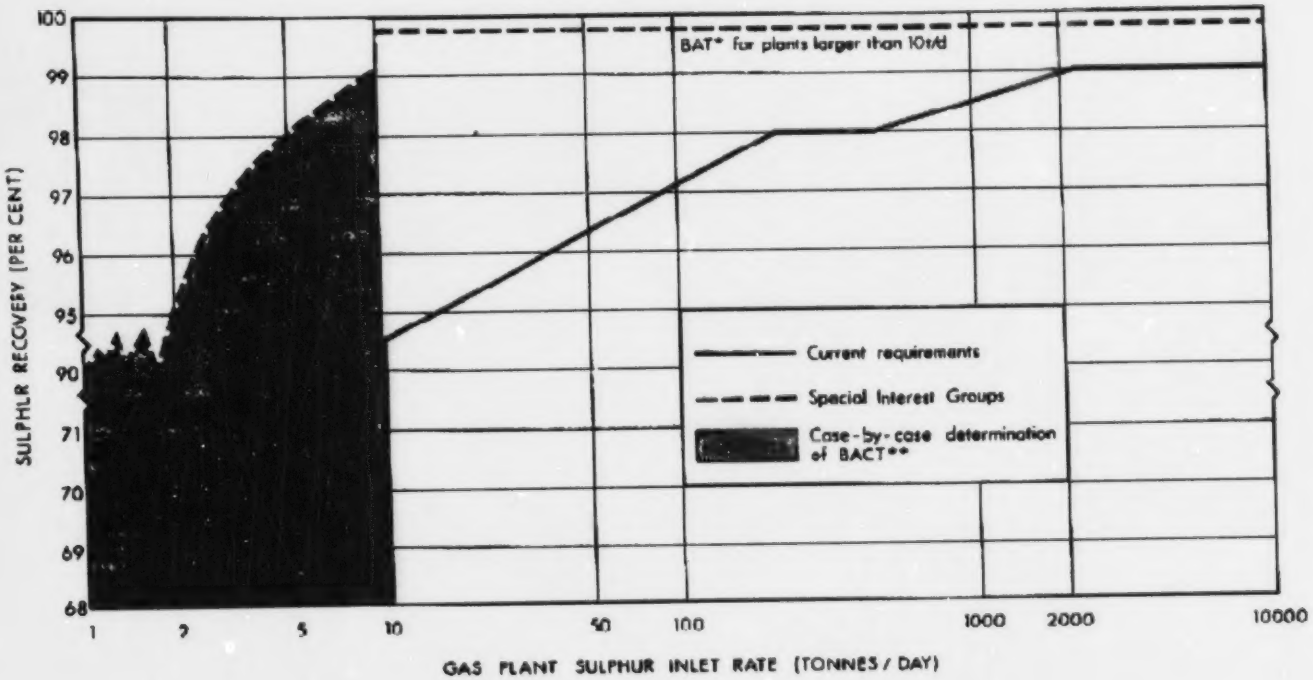

FIGURE 2 CURRENT SULPHUR RECOVERY REQUIREMENTS AND CHANGES RECOMMENDED BY THE SPECIAL INTEREST GROUPS

* Best available technology
**Best available control technology is the technology determined to be the best available for a plant having regard to economics and airshed pollution load

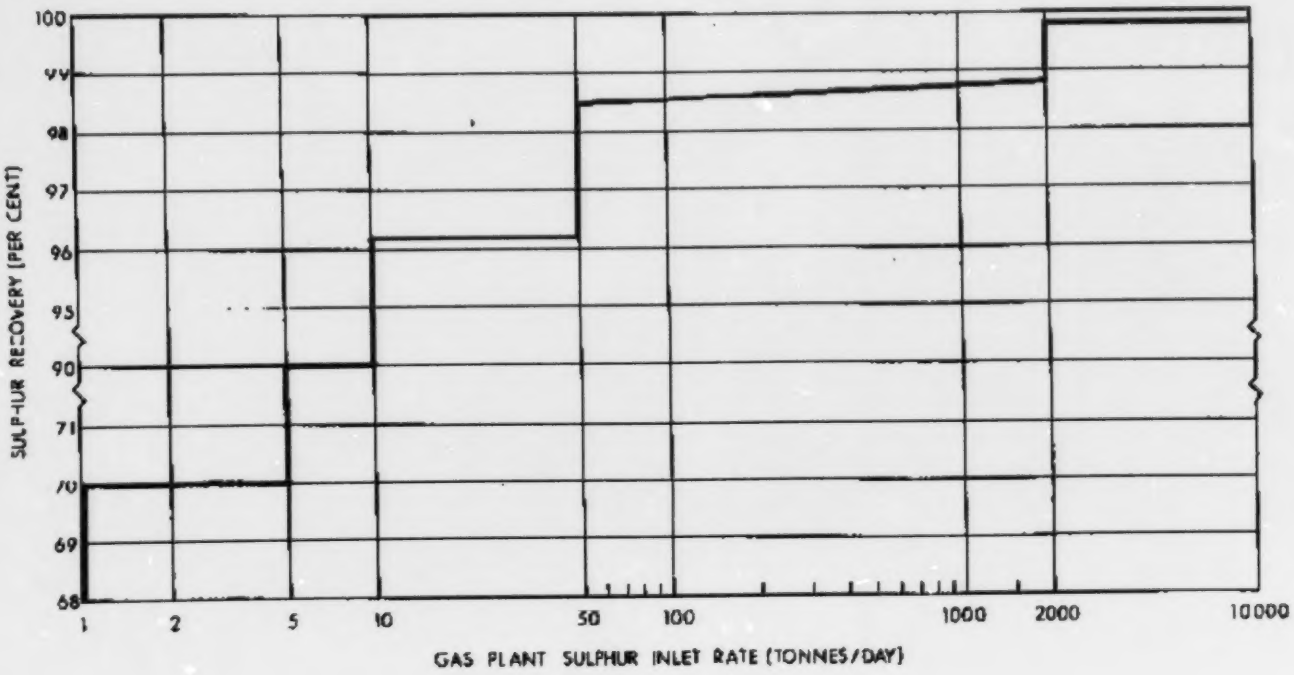

FIGURE 3 SULPHUR RECOVERY REQUIREMENTS* FOR ALBERTA SOUR GAS PLANTS - AUGUST 1988

*At normal operating conditions. Deduct 0.3% for quarterly average requirement